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PLEASANT HOURS WITH THE MICROSCOPE.

By HENRY J. SLACK, F.G.S., F.R.M.S.

AUTHORS usually lay all blame for mistakes to the printers, but I will be more generous, and confess I may have overlooked, in correcting the proof, that in the second paragraph, p. 316, Nemoptera appears instead of Neuroptera.

There is a common notion that insects are enormously strong for their size, which is true, without the fact necessarily leading to the fancy that if larger creatures had proportional muscular power, they could jump over steeples, and give mountains a shake. The muscular system of insects is, however, very wonderful and well worth examination. If, for example, the thorax of a wasp or bee is opened, the observer will see a number of yellowish bundles. A slight touch will separate them into fibrils, and, under the microscope with a power of about 300 ×, these will be resolvable into *fibrillæ*, very delicately striated across their length.

In the human body, and in invertebrates generally, the striated muscles belong to the voluntary system, and non-striated to most of those organs over which the will has no direct control. Siebold tells us that the muscular fibres of the insecta are striated, not only in the voluntary muscles, but often also in those of organic life, as in the stomach and intestines. Muscular fibres from the thorax of insects do not exhibit the striation nearly so plainly as those from some other parts. For example, such fibres from the thorax of a wasp require a little care in optical management for their striation to be seen at all, while in fibres from the muscles moving the stinging apparatus of a hornet, they are obvious with less magnification. The quantity of muscle in the thorax of a four-winged insect is strikingly large. The work to be done is to give due motion to six legs, besides the wings. The latter organs have to move with considerable rapidity during flight; but the space they traverse in each vibration is small. The wing movements are produced, according to Siebold, by two extensor and several small flexor muscles, which arise from the middle and posterior thoracic segments, and are inserted on a tendinous process at the base of each wing. In insects that use four wings equally in the act of flying, the muscles moving in two pairs are equally developed; but those of the anterior wings of bugs and some other insects whose flight is wholly or chiefly performed by the hind wings, are smaller in size.

The wings of dragon-flies, bees, and house-flies are strong and firm in proportion to their size, which enables them to oppose a considerable resistance to the air. According to an old observation of Leeuwenhoek, a species of dragon-fly outstrip a swallow which tried to catch it in a menagerie 200 feet long, but for this rapid flight the muscles are not required to make the wings vibrate any great number of times in a second. According to an article by Mr. J. Bishop, in Tod's "Cyclopædia of Anatomy and Physiology" an *Æschna*, causes its wings to vibrate ninety-six times in a second, as a preliminary to flying, when the vibrations become slower, but through larger arcs. The force employed as estimated by the weight moved through a certain space in a given time, does not appear so striking as when only the rapidity of the flight is considered.

If an insect is caught in the fingers its struggles to escape give the notion that its strength is excessive for its dimensions, and experiments to ascertain what weights insects can pull up inclined planes have been held to confirm the opinion. This, however, is controverted by M. Delbeuf, in a paper called "Nains et Géants ("Dwarfs and Giants") which appeared in the *Revue Scientifique*, Jan. 27, 1883. He cites M. F. Plateau's statements, derived from careful experiments, to the effect—"1. That in the matter of flight, insects in relation to their weight possess enormous strength compared with vertebrates; 2. That in the same group of insects the strength of different species varies inversely as their weights, or, in other words, the smallest are the strongest. If, says M. Delbeuf, the strength of a horse weighing 600 kilogrammes, as measured by Regnier's dynamometer, equalled 400 kilogrammes, and if a cockchafer weighing a sixth of a gramme could exert a force of sixty-six times its weight, it would be proportionably one hundred times the stronger, and 40,000 cockchafers would be equal to a large horse. "Must we," he exclaims "resign ourselves to be a hundred times less vigorous than a cockchafer, and two hundred times less strong than a small beetle that lives in dung?" He replies in the negative, and contends that the element of time is omitted in these calculations. "Suppose," he says, "a horse harnessed to a burden equal to half his own weight, and a chafer to another one fifty times its weight, if the horse raised his burden one mètre in a second, and the chafer required one hundred seconds to raise his to the same height, the two efforts would be proportionably the same." After giving many illustrations, M. Delbeuf concludes that all animals are about on a level, and that muscular fibre has the same properties, whether in a vertebrate, articulate, or mollusk.

To return to our insects, it is evident on inspection that their thorax contains a large quantity of muscular fibre in proportion to its capacity. There is no waste of space; the fibre is closely packed, and free from fat or other inert material, and the whole body of an insect is usually very muscular in proportion to its size and weight.

The muscular fibres of insects should be compared with those of other creatures. Any kind of meat well boiled is likely to show them plainly. A very small piece should be taken, teased out with a needle on a slide in a drop of water, and covered with a thin glass, and examined with a ¼ or higher power.

Amongst the aspects presented by striated fibrils under high magnification is one of a series of light squares, containing smaller and darker squares. These must be regarded as optical appearances, not positive exhibitions of structure.

Unstriated muscles are found in man and various animals in the alimentary canal, bladder, ducts of glands, &c. They have been generally considered to consist of elongated cells, but Professor Engelmann states that smooth fibres are really composed of fibrillæ.

They sometimes exhibit striæ, and there is no harsh and absolute distinction between the two sorts. The characteristic "vital property of muscular fibre," says Owen, "is to alter under stimulus its relative dimensions of length and breadth. When it becomes shorter and thicker, it is said to contract, and by these contractions the movements of the body and of its parts are produced."

THE UNIVERSE OF SUNS.

By R. A. Proctor.

(*Continued from p.* 370.)

IN far better accordance with modern ideas, are the views of the great astronomer Christian Huyghens, as expressed in his fine work the "Cosmotheoros."* He held that the sun is one of the stars and resembles them in size and structure. The distribution of the stars he regarded as in a general sense uniform, for he held that the same distance which separates the sun from the nearest star separates that star from the next beyond, that from the next, and so on to infinity. We have already seen that his hypothetical study of the universe led to researches and results of considerable importance.

We owe, however, to Thomas Wright, of Durham, the first attempt to form a complete theory of the universe. The Milky Way was not referred to at all in the speculations of Huyghens, nor was the important position of the star-cloudlets in theories of the Cosmos recognised in Huyghens' time. Wright's views ranged over the whole of the sidereal universe as known in his day; and we shall see that by a bold effort of genius he anticipated the speculations which the greatest of all astronomers based a few years later on observation.

Wright examined the structure of the Milky Way with a reflecting telescope only one foot in length, satisfying himself that the galaxy really consists of a multitude of minute stars. Reasoning concerning the Milky Way, he remarked that if we judge of it only by phenomena we must regard it as a zone of stars surrounding the heavens. But this conception of the Milky Way as a perfect ring is not in agreement with the irregular distribution of the stars which do not lie upon the galaxy, but seem dispersed promiscuously throughout the space surrounding us on all sides. It seems inconsistent with the harmony observed in "all the other arrangements of nature" that one scheme of stars should be arranged with perfect symmetry, while another is scattered irregularly. It is far more reasonable to conclude—so Wright reasoned—that the seeming incongruity is due only to the imperfect nature of our survey both as respects the extent of space and duration in time. "When we reflect,"† says Wright, "upon the various configurations of the planets and the changes which they perpetually undergo, we may be assured that nothing but a like eccentric position of the stars could occasion such confusion among bodies otherwise so regular: in like manner we may conclude that as the planetary system, if viewed from the sun, would appear perfectly symmetrical, so there may be some place in the universe where the arrangement and motions of the stars may appear most beautiful. If we suppose the sun to be plunged in a vast stratum of stars of inconsiderable thickness compared with its dimensions in other respects, it is not difficult to see that the actual appearance of the heavens may be reunited with a harmonious arrangement of the constituent bodies of such a system with respect to some common centre, provided it be admitted at the same time that the stars have all a proper motion. In such a system it is manifest that the distribution of the stars would appear more irregular the farther the place of the spectator was removed from the centre of the stratum towards either of the sides. It is also evident that the stars would appear to be distributed in least abundance in the opposite directions of the thickness of the stratum, the visual line being shortest in these directions; and that the number of visible stars would increase as the stratum was viewed through a greater depth, until at length, from the continual crowding of the stars behind each other, it would ultimately assume the appearance of a zone of light."

It will be observed that in these words we have a complete enunciation of what has been called the Grindstone Theory of the stellar system. The theory is based by Wright on observed facts precisely as it was afterwards based by Sir W. Herschel on other observed facts. Whatever credit appertains to the invention of the theory should in justice be ascribed to Wright, who thus, in 1750, reasoned out and clearly described the views to which Herschel was led in 1784. Wright did not convince his contemporaries, but their slowness of apprehension seems to afford no just ground for depriving him of the credit due to his sound analysis of known facts.

Wright further held that the Milky Way is only one of many systems of stars; though the other systems forming with our galaxy a system of star-systems, may not resemble the galaxy or each other in structure. There may be differences as striking as those which exist between the rings of Saturn and the belts of Jupiter. "Some systems of stars may move in perfect spheres, at different inclinations and in different directions; others again may revolve like the primary planets in a general level; or more probably in the manner of Saturn's ring; nay perhaps, ring within ring, to a third or fourth order."

Wright believed that the common centre around which the stars of the galaxy travel is an orb larger and more massive than the rest. He also considered that there are sidereal systems within the boundaries of the visible universe, and subordinate to the great system of the Milky Way. It is to such parts of the Milky Way that he refers when he speaks of "the immensity of space being occupied by an endless succession of systems, analogous in their structure to the great system" (the Milky Way) "of which the visible universe is composed (and of which they form part)." This seems clear from the way in which he reasons respecting other Milky Ways. For, referring to the theory that such systems exist, he remarks:—"That this in all probability may be the case is in some degree made evident by the many cloudy spots, just perceivable by us, as far without our starry regions, in which, although visibly luminous spaces, no one star or particular constituent body can possibly be distinguished *these, in all likelihood, may be external creations, bordering upon the known one, too remote for even our telescopes to reach.*"

(*To be continued.*)

* It is perhaps not very generally known that the Plumian Professorship of Astronomy at Cambridge was founded by Dr. Plumer as an expression of the pleasure he had derived from the perusal of Huyghens' Cosmotheoros. The work was recommended to him by Flamsteed, the first Astronomer Royal.

† I quote from an abstract of Wright's views in Grant's fine "History of Physical Astronomy."

THE CHEMISTRY OF COOKERY.

By W. Mattieu Williams.

XXV.

MY first acquaintance with the rational cookery of cheese was in the autumn of 1842, when I dined with the monks of St. Bernard. Being the only guest, I was the first to be supplied with soup, and then came a dish of grated cheese. Being young and bashful, I was ashamed to display my ignorance by asking what I was to do with the cheese, but made a bold dash, nevertheless, and sprinkled some of it into my soup. I then learned that my guess was quite correct; the Prior and the monks did the same.

On walking on to Italy I learned that there such use of cheese is universal. Minestra without Parmesan would there be regarded as we in England should regard muffins and crumpets without butter. During the forty years that have elapsed since my first sojourn in Italy my sympathies are continually lacerated when I contemplate the melancholy spectacle of human beings eating thin soup without any grated cheese.

Not only in soups, but in many other dishes, it is similarly used. As an example, I may name "Risotto à la Milanese," a delicious, wholesome, and economical dish—a sort of stew composed of rice and the giblets of fowls, usually charged about twopence to threepence per portion at Italian restaurants. This is always served with grated Parmesan. The same with the many varieties of paste, of which maccaroni and vermicelli are the best known in this country.

In all these the cheese is sprinkled over, and then stirred into the soup, &c., while it is hot. The cheese being finely divided is fused at once, and being fused in liquid, is thus delicately cooked. This is quite different from the "maccaroni cheese" commonly prepared in England by depositing maccaroni in a pie-dish, and then covering it with a stratum of grated cheese, and placing this in an oven or before a fire until the cheese is desiccated, browned, and converted into a horny, caseous form of carbon that would induce chronic dyspepsia in the stomach of a wild boar if he fed upon it for a week.

In all preparations of Italian pastes, risottos, purées, &c., the cheese is intimately mixed throughout, and softened and diffused thereby in the manner above described.

The Italians themselves imagine that only their own Parmesan cheese is fit for this purpose, and have infected many Englishmen with the same idea. Thus it happens that fancy prices are paid in this country for that particular cheese, which is of the same class as the cheese known in our Midland Counties as "skim dick," and sold there at about fourpence per pound, or given by the farmers to their labourers. It is cheese "that has sent its butter to market," being made from the skim-milk which remains in the dairy after the pigs have been fully supplied.

I have used this kind of cheese as a substitute for Parmesan, and I find it quite satisfactory, though it has not exactly the same fine flavour as the best qualities of Parmesan, but is equal to that commonly used by the Italian millions. The only fault of our ordinary whole-milk English and American cheeses is that they are too rich, and cannot be so finely grated on account of their more unctuous structure, due to the cream they contain.

I note that in the recipes of high-class cookery-books, where Parmesan is prescribed, cream is commonly added. Sensible English cooks, who use Cheshire, Cheddar, or good American cheese, are practically including the Parmesan and the cream in natural combination. By allowing these cheeses to dry, or by setting aside the outer part of the cheese for the purpose, the difficulty of grating is overcome.

I have now to communicate another result of my cheese-cooking researches, viz., a new dish—*cheese-porridge*—or, I may say, a new class of dishes—cheese-porridges. They are not intended for epicures, not for swine who only live to eat, but for men and women who eat in order to live and work. These combinations of cheese are more especially fitted for those whose work is muscular, and who work in the open air. Sedentary brain-workers like myself should use them carefully, less they suffer from over-nutrition, which is but a few degrees worse than partial starvation.

Typical cheese-porridge is ordinary oatmeal porridge made in the usual manner, but to which grated cheese is added, either while in the cookery-pot or after it is taken out, and yet as hot as possible. It should be sprinkled gradually and well stirred in.

Another kind of cheese-porridge or cheese-pudding is made by adding cheese to *baked* potatoes—the potatoes to be taken out of their skins and well mashed while the grated cheese is sprinkled and intermingled. A little milk may or may not be added, according to taste and convenience. This is better suited for those whose occupations are sedentary, potatoes being less nutritious and more easily digested than oatmeal. They are chiefly composed of starch, which is a heat-giver or fattener, while the cheese is highly nitrogenous, and supplies the elements in which the potato is deficient, the two together forming a fair approach to the theoretically-demanded balance of constituents.

I say *baked* potatoes rather than boiled, and perhaps should explain my reasons, though in doing so I anticipate what I intended to say when on the subject of vegetable food.

Raw potatoes contain potash salts which are easily soluble in water. I find that when the potato is boiled some of the potash comes out into the water, and thus the vegetable is robbed of a very valuable constituent. The baked potato contains all its original saline constituents which, as I have already stated, are specially demanded as an addition to cheese food.

Hasty pudding made, as usual, of wheat flour, may be converted from an insipid to a savoury and highly nutritious porridge by the addition of cheese in like manner.

The same with boiled rice, whether whole or ground, also sago, tapioca, and other forms of edible starch. Supposing whole rice is used, and I think this the best, the cheese may be sprinkled among the grains of rice and well stirred or mashed up with them. The addition of a little brown gravy to this gives us an Italian risotto.

Pease pudding is not improved by cheese. The chemistry of this will come out when I explain the composition of peas, beans, &c.

I might enumerate other methods of cooking cheese by thus adding it in a finely divided state to other kinds of food, but if I were to express my own convictions on the subject I should stir up prejudice by naming some mixtures which some people would denounce. As an example I may refer to a dish which I invented more than twenty years ago—viz., fish and cheese pudding, made by taking the remains from a dish of boiled cod-fish, haddock, or other *white* fish, mashing it with bread crumbs, grated cheese, and ketchup, then warming in an oven and serving after the usual manner of scalloped fish. Any remains of oyster sauce may be advantageously included.

I find this delicious, but others may not. I frequently add grated cheese to boiled fish as ordinarily served, and have lately made a fish sauce by dissolving grated cheese in milk with the aid of a little bicarbonate of potash. I

suggest these cheese mixtures to others with some misgiving as regards palatability, after learning the revelations of Darwin on the persistence of heredity. It is quite possible that, being a compound of the Swiss Mattieu with the Welsh Williams, cheese on both sides, I may inherit an abnormal fondness for this staple food of the mountaineers.

Be this as it may, so far as the mere palate is concerned, I have full confidence in the chemistry of all my advocacy of cheese and its cookery. Rendered digestible by simple and suitable cookery, and added, with a little potash salt, to farinaceous food of all kinds, it affords exactly what is required to supply a theoretically complete and a most economical dietary, without the aid of any other kind of animal food. The potash salts may be advantageously supplied by a liberal second course of fruit or salad.

MIND IN THE INFANT.

THE early and obscure beginnings of mental life as they manifest themselves in infants have always had a great and absorbing interest for mothers. But it is only within the last decade that it has been authoritatively recognised, that those very facts which are so fraught with interest to mothers are also of paramount importance to men of science.

The marvellous transition from the pathetic helplessness of the new-born babe to the grand capabilities of the adult man is a phenomenon which has always, it is true, called forth the speculations and attracted the attention of scientific inquirers. But these all (with one notable exception) failed to see, that if they hoped for an adequate solution of the problem, they must be prepared to take up their stand by the cradle, and ascertain there, by personal observation and experiment, how mind begins to unfold itself. For, as by no effort of memory can a man remember his own mental development during the first three years of his life, it is clear that the psychologist is inevitably driven upon one of two alternatives. Either he must infer what goes on in the mind of the child from what goes on in the mind of the adult, or he is bound to watch for each gleam of intelligence and sensibility as these reveal themselves to us through the medium of the cries, movements, and facial expression of the babe of a few weeks old. It is precisely this latter more satisfactory method which the psychologists abstained from adopting, and the natural consequence was that many fruitless controversies were waged over unreliable theories set up to explain the processes of mental development. We have said that there was one exception to the prevailing indifference shown to the phenomena of infant life; this was the German philosopher, Thiery Tiedemann, who at the close of last century held a professorial chair at the University of Marburg.

Exactly one hundred years ago Tiedemann published a series of carefully-recorded observations, arranged in journal fashion, and extending over the first two years of his child's existence. By means of this memoir he sought to promote the experimental study of the human mind, more especially as it displays itself at the commencement of life. His example, however, apparently stimulated no one to the prosecution of similar investigations, and, indeed, it is only through a translation of Monsieur Michelant's, published eighty-one years later in the *Journal de l'Instruction Publique*, that this remarkable record is at length brought within the ken of the ordinary reader.

Now, after the lapse of many years, there has been a sudden rush of psychologists into the hitherto neglected field, and this particular department of infant psychology has been enriched by contribution after contribution of varying value, but of constant interest, from the pens of Darwin, Taine, Egger, Preyer, Sully, Ferri, Pollock, Perez, &c.

But numerous as are the facts chronicled by practised observers, such as are the foregoing, there yet remains wide scope for the exercise of parental activity in collecting still further data, and so assisting to constitute what has been aptly designated an Infant or a Nursery Psychology.

We cannot, therefore, too emphatically impress upon parents—more especially upon mothers—the wisdom of keeping an accurate register of all the varied phenomena they note in their offspring; and, in order that they may do this to really good and practical purpose, we propose, in a series of articles, laying before them all that is at present known with regard to this singularly interesting subject, and inviting them to inform us how far the facts they themselves observe corroborate or conflict with the conclusions which have been come to.

Still more to guide them in their work of observation, we shall subjoin tables showing the acquisitions of different infants during each month of their first year and each quarter of their second and third years. We shall also suggest simple experiments which may be tried upon infants when the elucidation of debatable points is in question.

And lest mothers should imagine that they are being invited to take up this work of minute and detailed observation merely in the interests of a science which they may or may not care to advance, we would refer them to an admirable article in *La Revue Scientifique*.

The writer, Monsieur Compayré, here points out forcibly how great is the assistance which a knowledge of the mental phenomena of infant life is calculated to give the educator. Education, he says, being nothing but art intervening to direct and control natural tendencies; it is impossible to make much way if the educator does not know the needs of children in order to satisfy them, their capabilities so as to call them forth, and their powers so as not to put too severe a strain upon them. In short, he says the artificial methods of education can only succeed when they are modelled upon the first steps of Nature herself—that is to say, upon those natural processes which we can see going on in the early life of the infant.

He then cites as an instance of the sort of knowledge needed by those who have the care of children, the well-known psychological fact, that a quite little child cannot fix its attention for more than five or six minutes at a time, while even with children of more advanced growth, half an hour of concentrated attention is the utmost they are capable of yielding without short intervals of rest and recreation. How often does a mother punish her child for its obstinacy in not attending, when, really, the blame should fall upon her for her folly in not acquainting herself with the laws of its nature. How often, again, does she not attempt to develop some faculty, without knowing that she is, all unwittingly, helping to impede its exercise.

In the interests then of the infant, even more than in those of the psychological philosopher, it is time that the different facts of infant mental life should be carefully systematised and placed within the reach of the mothers of England. And this is what, in a series of some dozen articles, we shall now attempt to do.

A. M. H. B.

TRICYCLES IN 1883.

By John Browning,

Chairman of the London Tricycle Club.

THE ROVER—THE NEW RUCKER—THE COBWEB—THE COVENTRY TANDEM—AND THE OARSMAN.

SOME months since an article of mine appeared in Knowledge, "On the Form of the Tricycle." In this article I referred to the various good points of rear-steering machines. The article was, I regret to say, greatly misunderstood. Many of my readers jumped at the conclusion that I recommended rear-steering machines in preference to front-steerers. This was far from my meaning. What I strove to show was this:—That the faults of rear-steerers were not due to their being rear-steerers, but were due to details of construction. These faults were mainly two. They were only single drivers, and the action was not sufficiently vertical—that is, the rider sat too far behind the pedals and thrust at them, instead of sitting more directly over them and using his weight upon them.

I argued that, if these faults were corrected, the rear-steering machine might, from the facility with which it can be mounted and dismounted, from its smaller weight and its more graceful appearance, regain the ground it had lost, and again come into public favour.

About a fortnight ago, Mr. Leni, of West Kensington, drew my attention to a new rear-steering tricycle, the "Rover," made by Starley & Sutton.

My tricycling readers will understand, I believe, what this tricycle is like when I tell them that it is a "Meteor," in which the pedals are well behind the axle, which runs right across the machine, and that the rider's saddle is supported on an Arab spring placed on the backbone, and that the machine is a double-driver by a balance gear.

The machine combines the advantages of a hind-steerer with those of a front-steerer, and has some of the best points of the "Humber." It can be mounted and dismounted easily from behind, while it is just as easy to dismount from the front should it be desirable to do so.

The axle runs through a hollow casing, which does not turn round.

When running down hill, the feet are placed on this axle as a foot-rest; in the event of an accident, the hind-wheel would tip-up, and the rider come down on his feet, instead of falling mixed up with the machine, as he would were he riding a front-steerer.

The makers are prepared to supply the "Rover" with driving-wheels as small as 42 in. These should be geared-up to from 46 in. to 56 in., according to the strength of the intending rider.

If the machine could be supplied with a two-speed gear working down to 35 in. for hill-riding, and up to 55 in. for good level roads, or slight downward inclines, it would be one of the best and fastest machines of the day. It appears to be well made and finished, and lightness has been fairly studied in its construction. I have driven it as fast as I can ride over a good road, and also over the worst road I could find—some inches of mud and new stones—and it behaved well on both. Experience will, I do not doubt, prove that this machine can with practice be ridden down hill as fast as any front-steerer. If so, the hind-steering machines must again be considered as equal to the front-steerers, and further improvements may be looked for in their construction.

I shall expect to hear of some good work being done on the "Rover" next season. I should like to point out that this is another case of a good and well-planned machine in which a considerable amount of the weight of the rider is thrown on to the small steering-wheel, though the opponents of small wheels declare that the necessity of doing this in machines made with them is an insuperable obstacle to their adoption.

To Starley & Sutton belongs the credit of having introduced the "Meteor"—the first hind-steerer which achieved a great popularity. The credit is now due to them of bringing out the improved hind-steerer, the "Rover," as an advance upon any front-steering machine made.

Mr. Rucker has kindly shown me a new front-steerer he has just designed, which has some important advantages over any other front-steering machine.

Unlike most front-steerers, this machine can be mounted and dismounted with equal facility, either from the back or front. It is a vertical-geared double driver, with bicycle pedals, adjustible in length of throw to suit the rider, and will shortly be supplied with a two-speed gearing when ordered. It is exceedingly light, and the workmanship is admirable. Mr. Rucker has been so good as to undertake a commission for me for one of these machines, with a two-speed gearing, and the wheels to be only 38 in. diameter, to my own specification. I expect to find this a very fast, safe, and convenient mount, and I will report on its performance as soon as I have done some work on it. I am decidedly of opinion that it is the best front-steering machine I have yet seen.

The new "Rucker" can in a few minutes, by only reversing the position of the driving-wheels to the opposite sides, be converted into a hind-steerer, when it possesses many of the advantages of the "Humber."

In the course of these articles I have frequently referred to the excessive weight of tricycles.

The first "Sociable" tricycle I had weighed 186 lb.; this was a first-class manufacturer's ordinary make. The second weighed 150 lb., the third 133 lb.; both these machines were made to my own specifications. I have just had completed for me a new "Sociable," which one of my cycling friends has christened the "Cobweb." This weighs only 80¾ lb., and I believe it possesses surplus strength for the work required of it.

Mr. Hirst, of Croydon, in carrying out my designs for this machine, has shown himself an artist in tricycles. Every separate piece has been fashioned into the most shapely form, with a minimum of weight and maximum of strength. All the handle-rods, seat-rods, and brake-rods, as well as the whole of the frame, are of weldless steel tube. The wheels, which are 36-in. diameter, have hollow rims and laced spokes. The suspension saddles have skeleton frames. Every piece of the work, besides those mentioned, is forged out of the finest Bessemer mild steel, which will bend, but will not break. It is, perhaps, desirable to say that such work cannot possibly be supplied at the price charged for machines in which many of the parts are of malleable iron castings. On this machine I am able to drive a heavy man, not working, over a rough road.

I have just seen and tried a new single front-steering tricycle invented by the Rev. J. M. Taylor, of Seer Green Vicarage, near Beaconsfield. This machine is known as the "Oarsman." It has a sliding-seat, and the action is that of a rower sculling, though there are no oars to the machine, but two handles that run parallel with the sides. The rider can exert enormous force by reaching down nearly to his feet, and then pulling up in a straight line, bringing himself to his full length in an inclined position.

The roads were in a shocking condition when I tried the "Oarsman," but I can readily believe that, when the conditions are favourable, great progress can be made with this machine. The driving wheels run with a new clutch,

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and from 10 to 20 yards can be covered with a single pull of the handles.

The new Coventry Rotary Tandem is a "Sociable," made on the same lines as the single machine, but with a second seat and pair of pedals and chain wheel, all of which can be removed in a few minutes so as to convert the machine into a single when required. It is very light for a Sociable, the weight being about 95 lb. It is an exceedingly fast machine, but would require rather careful riding, and is more suitable for two gentleman than for a lady and gentleman. Still a lady could ride on the front seat, and, as there are two steering-handles, a gentleman riding behind could steer.

ASTRONOMICAL COLLISIONS.*

By Prof. C. A. Young, Princeton, N.J.

THE universe of space is, in one sense, full and crowded. Everywhere our telescopes find stars; and for every one we see there are probably hundreds, and even thousands, too faint or small or far away to reach our senses. And of this countless host of worlds not one is at rest, but all are rushing through space, free and unbridled, with velocities far exceeding anything in the range of our terrestrial experience. Our swiftest cannon-shot takes more than three seconds to go a mile, but the stars and planets seldom move slower than five miles a second, and some of them go two hundred. The veriest snail among them would overhaul a rifle-ball in the same sort of way that the rifle-ball would overtake a receding freight-train. Is there not, then, danger of collisions? Have such collisions ever occurred; and, if so, with what consequences?

Now, in the first place, it is only in a sense, and rather a Pickwickian one, that space can be called crowded. True, stars are to be seen in every direction; but this is because our vision reaches so unimaginably far. If we restrict our consideration to bodies of respectable magnitude,—a hundred miles in diameter, for instance,—we ought rather to say that space, instead of being crowded, is almost inconceivably empty. Between any star or planet and its nearest neighbour, lie usually desolate distances of millions, or even millions of millions, of miles. If we assume, what is probably an under-estimate, that the region commanded by our telescopes is so vast that light takes a thousand years in coming to us from its outer confines, and, further, that the number of its stars is a thousand millions (the number visible with our largest telescopes is usually estimated at about sixty millions), then we find that the average distance from star to star must be about nine millions of millions of miles. This is not quite half the actual distance from the sun to our nearest stellar neighbour (α Centauri), according to the received value of its parallax; but it is a distance which quite defies the power of human comprehension. If two stars at such a distance were rushing straight toward each other with a speed of ten miles a second, it would require nearly 30,000 years to bring them together. Represent the sun, as in Sir John Herschel's familiar illustration, by a globe 2 ft. in diameter, so that oranges, cherries, peas, and pins'-heads would stand for the different planets at distances ranging from 80 ft. to two miles, then, on that scale, α Centauri would be 8,000 miles away. Obviously, there is plenty of elbow-room in the universe, and the chance of two stars accidentally jostling each other is far less than that of the collision of two bullets in mid-air over a battle-field. Still the possibility remains.

* From the *North American Review*.

There is a prevalent impression that the immunity from collision between the heavenly bodies depends mainly on their being held in orderly orbits by central attraction; and it is true that their orbital constraints make it quite impossible for the *planets* to collide with each other, or even to approach each other very closely. But a very impressive picture is sometimes drawn of what would happen if the earth, for instance, should some time free herself from the bonds of gravitation—how she would fly off into space (which is true, of course), and soon dash herself to pieces against some other wandering world (which is not true at all, or at least not probable). Most likely, if gravitation were suddenly to cease, the earth would travel for millions, not of years, but of ages, without ever encountering anything more important than meteors such as are now continually falling upon her surface. And these meteoric encounters, even, would probably be far less frequent than at present, since there is reason to suppose that such bodies are much more numerous in the neighbourhood of the sun, and of other great stars, than in the rest of space.

Evidently, however, the attractions between a wandering star and others lying near its path must considerably increase the chances of collision, though not to so great an extent as perhaps might be supposed. A body entering our system at a distance from the sun one hundred times as great as the radius of the earth's orbit, and moving with no more than the velocity natural to a comet at that distance (about $2\frac{3}{4}$ miles per second), would not strike the sun unless its path were directed within less than half a degree (23.′4) of the sun's centre; and if its velocity were greater, the aim would have to be still more accurate to score a hit. If bodies were shot into space at random from the position and with the velocity indicated, only about one in eighty-six thousand would hit the sun. Were it not for the sun's attraction, however, the proportion would be twenty thousand times smaller still—only one in seventeen hundred millions.

It is obvious, therefore, that encounters between heavenly bodies of considerable magnitude must be extremely rare. There is not in all the astronomical record a single certain instance of such an occurrence. And yet it may confidently be asserted that some time or other in the past such events must have happened, and some time in the future will happen again; simply for the reason that, in a sufficient length of time, the most improbable things, if only not impossible, are sure to come to pass. Now, it is almost certain that the stellar motions are not such as to render collisions impossible: the planets, it is true, as has been said before, can never run into each other, because of the size and nature of their orbits, but, so far as can now be ascertained, nothing of the sort holds good for the motion of the stars. We already know enough about some of their so-called "proper motions" to be quite sure that, as a fact, they are not travelling in any simple curves around any common centre, and also that some stars are flying through space with such velocities that no attraction, such as can reasonably be supposed to act in the premises, can control them. Nor does theory, any more than observation, indicate a structure of the stellar universe at all analogous to that of the planetary system. Among the stars there is no central dominance and no imperial power, but we have to do with a republic of comparatively free and independent members.

Sir William Thomson is therefore fully justified in writing: "It is as sure that collisions must occur between great masses moving through space as it is that ships, steered without intelligence to prevent collision, could not cross and recross the Atlantic for thousands of years with immunity from collision." Undoubtedly, the chance of an

encounter between a pair of heavenly bodies, selected at random, is trifling, almost beyond the power of computation, and the intervals of time between such catastrophes, in that part of the heavens subject to human observation, must be, on the average, enormous; but yet, in infinite time and unbounded space—somewhere or other now, sometime or other here—such things are happening, or will come to pass.

To be continued.

RECREATION BY WONDER.*

NEXT to uncertainties as parts of recreation, I named wonders, meaning to include the objects of all forms and degrees of wonder, from quiet admiration to utter astonishment or awe. Of course, the issue of a chance or of a game of skill may excite wonder, and its use for recreation may be thus enhanced; but we may think of the recreation due to wonders as something distinct. Their fitness for recreation is as evident as that of uncertainties, and similar. Whatever most men's daily work may be, or wherever they may pursue it, they become so accustomed to it, so familiar with all around them, that they may cease to wonder at anything within their range. They may have their work in the midst of glorious scenery, among mountains, or by the sea, or in their own rooms among marvellous beauties of art, but they observe little or nothing of all this; or they may be working at any of the applications of the wonderful discoveries of recent times, but they have long ago ceased to be astonished at them. Some of us may, indeed, upon reflection or in calm thinking, be moved by the wonders among which we have been living: they are very happy times when we can so meditate; but usually and habitually we are seldom conscious of any stirring wonders in our customary work. The finding and observing of them elsewhere is, therefore, a real recreation, and a chief part of a very large number of the mental refreshments which we most earnestly seek and most thoroughly enjoy. And happily it is so; for the contemplation of wonders may give occupation, and thereby strength, to one of the noblest parts of our minds—the part which not only, as Aristotle pointed out, first leads to studious research, but that which is exercised in the highest admiration and reverence, and which acts, together with the imagination in the forming of the highest ideals towards which we can ever strive.

It is easy to find instances in which the greatest charm of recreation is in the wonder to which they move us. I watched one in myself some weeks ago when I went over the electric-lighthouse on the Lizard Point, enjoying and feeling refreshed by all the wonders that I saw there: the wonders of the burners that would give the light of many thousand candles; and of the multiplied reflectors and lenses by which, of all this light, none might be wasted, but all sent right out to shine for miles over the sea; the admirable cleverness and precaution by which, if the electric light were, by any accident, hindered, a huge paraffin lamp, with its concentric wicks, would instantly take its place; and then the wonders of the fog-horn, with its great reservoir of air so condensed by steam-pressure that, being let go, it would blow a blast upon the horn which should be heard out at sea miles beyond the distance at which, in the dense fog, the light could be seen.

I wondered at all this and was refreshed; and I wonder still as often as I think of it, and thus constantly renew my recreation. And I think, too, of the contrast between myself and the keeper of the lighthouse who showed it to me. He was an admirably intelligent workman, complete in his knowledge of the machinery; as complete in his knowledge as I was in my ignorance; proud, too, of the work in which he was engaged, and happy, I think, in its utility. But to him it was no wonder; he showed it with all the quietude of routine, and spoke rather wearily of the hours spent in watching it. To him there was no recreation in it all; it was the object of his daily work.

The same charm of wonder and the same kind of contrast may be found in a thousand other instances. We enjoy the surprises of conjuring tricks, which to the conjuror himself, I suppose, give no stirring pleasure; and of fireworks, and the stories and actings of perilous adventures. More worthily, we may enjoy and be refreshed by the marvels of skill in art, in music, or in singing. When we listen to a long-sustained high note—such as Albani can sing or Joachim can play—we are refreshed not only by the beauty of the sound, but by the wonder that it can be produced; and it is this which most refreshes us when, long afterwards, we can recall the sound. It is after the same manner that we are refreshed by glorious scenery, the grandeur of mountains, of cataracts, of floods of light at sunset: they move us to wonder, and we enjoy them and they refresh our minds, though those who live among them may be unmoved. And so it is when we leave home and find recreation in the strange sights and customs of other cities; and foreigners come here and are as happy in their wonder at the things which we are tired of looking at. What would not one give to be able to come to London as a stranger and be surprised at the sights that, unless in careful thinking, we now care nothing for?

* From an article by Sir James Paget in the *Nineteenth Century*.

A Cat upon a Roman Tile.—At Dowgate-hill the roadway known to the Romans was 14 ft. or 15 ft. beneath the present pavement. To that extent Roman London is beneath us, just as old Rome underlies the modern City, ancient Jerusalem the modern Holy Places, and the Troy of Homer the existing Hizarlik. One very striking remnant of the conquerors was found in this classic spot. It was a Roman tile, 13 in. square and 1½ in. thick, and had formed, according to the usual practice of those expert and substantial builders, part of a layer of a rubble wall. But that which made it strikingly interesting was the impression of a cat's foot distinctly marked in one corner. It was a fossil imprint of the most perfect character. *Pussy had left the stamp of her paw on the soft clay.* The British or Roman brick-maker, without heeding it, had baked his brick carefully and well, and there, after fifteen centuries, was the impression as distinct as if it had been struck on a coin but yesterday. It was a type of what the geologist is familiar with. Mr. Charlesworth found the impress of a butterfly in strata that had been buried more than as many thousands of years; Lyell has recorded footprints of birds and reptiles in rocks that must have been many ages old, ripple marks on the sandstones of seas in vastly remote epochs; while in the Laurentian rocks of Canada Dr. Dawson has traced marks of lowly forms of life that must have been embedded or imprinted millions of years ago. So might it have been with pussy's footprint. She and her mistress—perchance a Roman lady of high degree, possibly with a residence hard by in Watling-street—and everything that pertained to the Roman occupation might have been things millions of years gone by, and yet that footprint has remained as fresh as it is to-day.—*Daily Telegraph.*

XUM

THE BÜRGIN DYNAMO-ELECTRIC MACHINE.

ONE of the most interesting, most efficient, and withal most mechanically perfect machines ever produced is the one which we owe to the ingenuity of M. Bürgin, of Bâle, supplemented by the talented improvements of Mr. Crompton, of Chelmsford, and which is represented by Figs. 1 and 2, Fig. 1 showing the commutator and Fig. 2 the driving pulley. Fortunately for most parties, if not for all, M. Bürgin's invention has not been made the subject of any great amount of speculation. It is therefore free from the troubles and difficulties which beset many another machine from such a cause, and it is in consequence placed on the market at a price which renders the adoption of the electric light more than usually practicable.

To find the parent idea apparent in the construction of the machine, we must go to the Gramme, upon which, however, the Bürgin is in many critical points a decided improvement. Our readers are doubtless aware that in the Gramme machine the armature, or that part in which the current is generally speaking said to be generated, consists

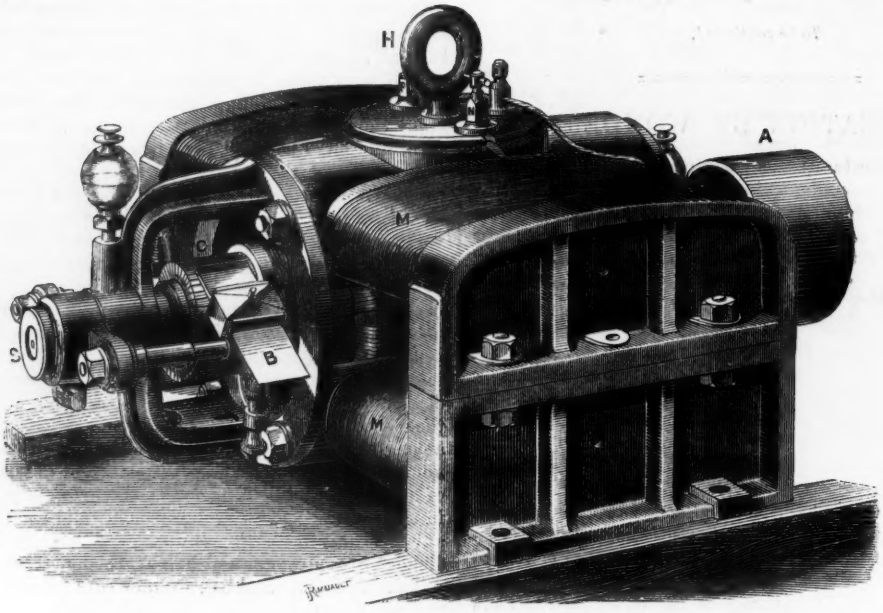


Fig 1

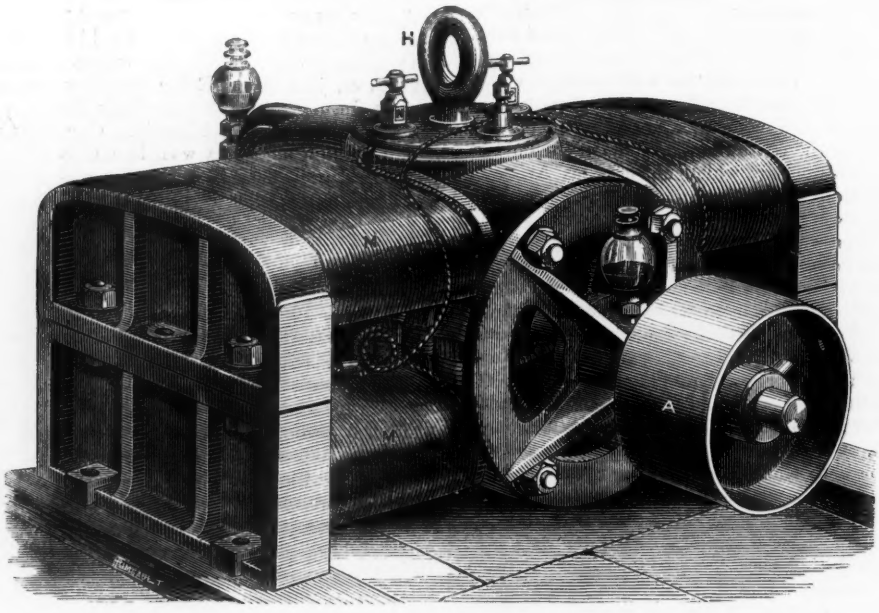


Fig. 2.

of a coil or ring of iron wire over which a series of coils of copper wire are wound. These coils are continuous, that is to say they are side by side, and so form a compact ring in which the iron core is entirely covered. This ring in

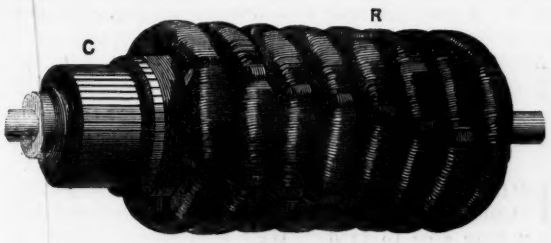


Fig. 3.

being fixed has to be forced on to a wooden spindle, so that in revolving the rotation of the ring is dependent upon the friction between the cotton-covered wire and the wood. As the tendency of the current in the inducing or field magnets is to arrest rotation (otherwise no current could be generated in the ring), it is manifest that to attain high velocities with safety, some device of a higher mechanical order is desirable. This is one of the many advantages pertaining to the Bürgin dynamo. The armature (Fig. 3) consists, not of one but of a number of rings, each ring being composed of a coil of soft iron wire pressed out into a hexagonal shape, so that there are six corners, all of which would be touched by a circumscribing circle. On each straight section of the iron core—or, in other words, on each side of the hexagon—are wound five layers of cotton-covered wire (W, Fig. 4), each layer being shorter than the subjacent one, so as to give, when the six coils are finished, an approximately complete circle externally. A piece of gun-metal (J), star-like in shape, with six spokes or radiations, is then forced very firmly into the ring, each spoke finding its position in one or other of the corners of the hexagon. The gun-metal star has a hole in the centre through which an iron spindle (S) is passed and made rigid. It will thus be seen that the mechanical virtue is exceedingly good and almost perfect. Six, eight, or more such rings are placed on the spindle, and constitute the armature. In the Gramme machine *contiguous* coils are connected together, and in the Brush machine, it may be remembered, the *opposite* coils are connected; but in the Bürgin machine the connection is materially different, very novel, but also very ingenious. The arrangement is to connect, say, the first coil of the first ring to the coil of the second ring which is next behind it, and thence to the next succeeding coil of the third ring, and so on, each ring being one forty-eighth of a revolution behind the one electrically in front of it. (See Fig. 3.) Supposing the armature to have six rings, the sixth coil of the sixth ring is connected to the second coil of the first ring, which is again connected to the third coil of the second ring, and so on till the series is completed. This gives to the armature all the advantage of the Gramme ring, besides which it is worth noting the open nature of the structure, and the absence of non-conducting materials helps very materially to keep the machine cool, a highly-desirable result, which is further assisted by the comparatively very small quantity of copper wire employed. It must not be forgotten that apart from the mechanical objection to heating, an increase of temperature affects adversely the resistance of the wire. The commutator, or that part of the machine where the current is made to pass out of the armature into the field-magnets and the external surface, is similar to the Gramme, the junction of each pair of coils being connected to the same sectional strip of phosphor-bronze (a very durable metal which is used for the purpose). Not the least of the advantages embraced in M. Bürgin's invention is the great facility with which the armature may be taken to pieces for examination or repairs.

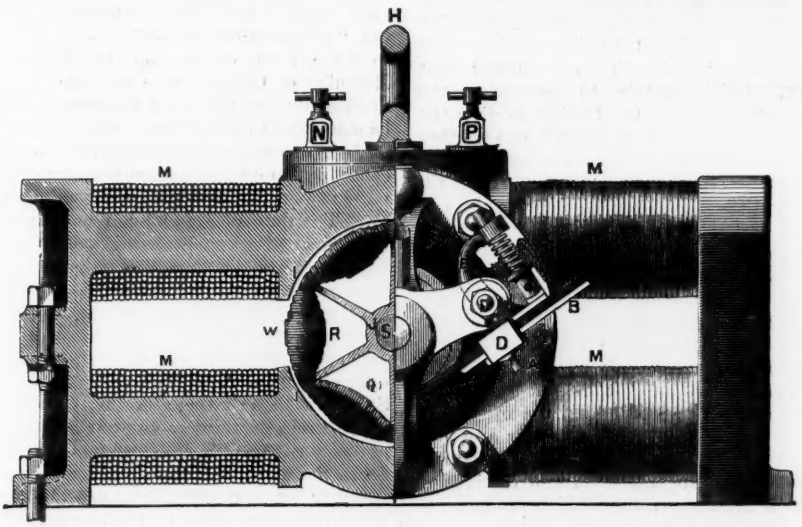


Fig. 4.

The generating or field magnets (M, M) are well depicted in Figs. 1, 2, and 4. The whole of the iron framework and the cores of the magnets are cast in two pieces, one of which is placed above and the other beneath the armature. The cores are of oval section, and the wire is so wound as to make the two crescent-shaped pole-pieces, which almost envelope the armature, of opposite polarity.

Want of space compels us to defer for a fortnight the completion of our remarks on this dynamo.

THE "VIBRATO."*

SOME years ago an exhibition of various manufactured articles was opened in London, one room being set apart for selected specimens of the worst taste, and intended to serve as a warning. In this chamber of horrors a gentleman in the carpet trade espied a design with the name of his own firm pilloried thereon. "Well," said he, "it may be ugly, but they have hit upon the very pattern we sell most of." It must be acknowledged that our vocalists, male and female, native and foreign, with only a few glorious exceptions, have adopted the system of the carpet-maker, and submit to the public, not the best, but the most saleable wares. There exists at present a great demand for the execrable quality of tone called the "Vibrato" or the "Tremolo" (thank Heaven there is no English word for it), and most abundant in consequence is the supply. Now, people are not generally aware that in this intermittent character of tone lies the very essence of dissonance, and this admits of an easy illustration.

Take two tuning-forks in unison, slightly alter the pitch of one of them by loading its prongs with a small pellet of wax, and sound the two together. If the forks are mounted on what are called resonance boxes, the effect is more striking, but it is sufficient to place the handle of each on a wooden board or table. Then are heard what are termed "beats," which imitate to perfection the vibrato of our operatic singers. On further loading the fork, by fixing a small coin, the beats succeed one another more quickly, and, in fact, the greater the interval the more rapid the beats. We may continue the process till we can no longer count them, or even distinguish them as separate strokes of sound. Still the intermittent character, the unpleasant roughness, remains, attaining its maximum when the forks are a semitone apart, and disappearing at about a minor third, which is called the beating distance. Now, every musical note is compounded of a fundamental and several partial tones, the whole constituting what is called a clang, and Helmholtz has shown that a dissonance can arise only when the notes of one clang are within beating distance of the notes of the other. It amounts to this, that consonance is a continuous and dissonance an intermittent sensation of tone, and that the latter is due to alternate augmentation and diminution of sound; in fact, to the same causes which produce the "vibrato."

Is it not, then, monstrous that singers should introduce, and that listeners should be found to tolerate, that which is simply the foundation of discord? If it should happen to be a consequence of failing powers, we must make the best of it, in consideration of other compensating qualities, supposing such to exist. But indulgence may be, and is, carried too far. Thus we often hear what is called a high chest note applauded, not for its quality, which is doubtful, nor for its effect, which is generally misplaced, but as a recompense for the evident and intense effort required to produce it.

There is in all this between the public and the singer a mutual reaction fatal to the interest of art. Dramatic effects, utterly without novelty or refinement, are forced upon the audience by the performer, who himself gives the well-understood signal for applause. What wonder that these tricks of the trade should be resorted to as a substitute for the results of long and conscientious study? On the other hand, people will not pretend to be wiser than their neighbours, and they imagine that such popular and highly-paid artists can do no wrong.

It is time to protest. Singing as an art is undoubtedly on the decline. There is no lack of fine voices, but pure and equal vocalisation is almost a thing of the past. It is not to be expected that many people should trouble themselves with the physical reasons for a disagreeable sound, but it is a great gain that science should come to our aid by confirming and justifying our unfavourable impressions.—Frederick Ricardo.

* From the *Choir*.

AN ANCIENT COMET.

THE Greek writer Apollonius states that the Babylonians regarded comets as wandering stars, and that they were able to predict their appearance. There is little doubt that the Greek astronomers derived much of their early astronomical knowledge from Chaldea, and that many of the curious omens and superstitions connected with the stars, comets, and other celestial phenomena, which survived until the middle ages, had their origin in the astrological works of Chaldea. The great astronomical work, consisting of seventy tablet-books, which formed the standard work of the Babylonians was called "Nānnar Beli," the "illumination of Bel," was by the Babylonians said to have been drawn up by Sargon of Akkad, the Romulus of Chaldea, who was the founder of the great Semitic dynasty of North Babylonia. This dynasty might be compared to the Ming dynasty of the Chinese, for it was during, according to tradition, his reign that the great consolidation of Babylonian literature took place, and the various encyclopædic groups of tablet-books were drawn up. The date of this king is now fixed by a passage in a recently-discovered inscription as B.C. 3750, and contemporaneous inscriptions of Sargon and his son have been found at Aboo Hubba by Mr. Rassam. There is in the British Museum a copy, from the library at Nineveh, of a chronicle of his reign, each chapter or paragraph of which begins with a statement as to the omens of the moon at the time the event took place. Several tablets of the great astronomical work have been published in the third volume of the "Cuneiform Inscriptions of Western Asia,"* and some have been translated by Professor Sayce in his valuable paper on Babylonian Astronomy ("Trans. Society Bibl. Arch." Vol. III., pt. ii.). The more complete study of the ancient Akkadian dialects of Babylonia, in which most of them are written, and the great increase in the number of inscriptions enables us now more fully to understand these very difficult texts. The obscurity of the inscriptions of this class is not a modern difficulty, for we frequently find the scribe noting in the text phrases which could not be explained, or slavishly copying the archaic text of the Babylonian version. It is this great work which must now become our standard text-book for the study of the astronomy and astrology of the ancient Babylonians. Turning to it to see if there is any trace of the fact stated by Apollonius, as to the Babylonion knowledge of comets and the portents derived from them, we find in the opening tablet, which is a sort of summary of the contents of the work (W. A. I., Vol III., pl. 52, No. 3), the following passage. "Omens (of the) heavens from the star which before it a hairy crown and behind it a tail makes." In another fragment (W. A. I., II., pl. 49, l. 13) we have a similar description —"the star which after it a tail like a shadow makes." These show that omens of the class referred to by Apollonius were included in the work. We have, however, in

* Throughout this communication, this title will be abbreviated as W. A. I.

the series a very fine specimen of this class of tablets relating to the appearance of a comet, of which we can probably fix the date, and giving the omens which the astronomers deduced from it. This tablet is the copy of an ancient Babylonian document, and was preserved in the library of Assurbanipal (B.C. 668), at Nineveh (W. A. I., Vol. III., pl. 52, No. 1). The translation I propose is as follows:—

(1) The star rises, its rays are bright like the day.
(2) With its rays like a creeping thing, a scorpion, a tail it forms.
(3) The observation to the sight was favourable, pleasing the lord of this house, who in all the land was established.
(4) At that time (when as yet) a lord there was not in all the land.
(5) Rebellion, defection, sin, there was. A strong one exalts himself
(6) who comes forth and spreads out. The
(7) Lord of this house, and this king in his right is established—and peace and obedience in the land is.
(8) These things which from the star (are seen)—
(9) The great star from the Northern* orbit (line)
(10) To the Southern orbit
(11) In its extent, like a creeping thing a scorpion a tail makes,
(12) Turning upward. In its position at night
(13) the house of Bel it fills.
(14) These are according to the words of the tablet,
(15) When Nebuchadnezzar the king to the land of Elam went.

As this tablet was found in the library of Assurbanipal, it stands to reason that this Nebuchadnezzar cannot be the great Babylonian king, who did not rule until half a century later. We have, however, in the canonical lists of Babylonian kings and in the early historical records two kings of this name mentioned. One of these monarchs, called "Nebuchadnezzar the son of Bazi," ruled at a very remote period. There was, however, a second king of this name, who was the contemporary of Assur-ris-ilim and Tiglath Palieser I. in the twelfth century before the Christian era. This latter is the monarch to whom the omen-tablet refers, and from an inscription recently discovered by Mr. Rassam at Aboo Hubba we may certainly identify the king and possibly fix the date of the comet. From the tablet of Synchronous History (W. A. I. II., pl. 65, col. 1) we learn that in the last years of Assur-ris-ilim this monarch invaded Assyria, but, owing to the burning of his camp, he had to retreat. Soon after this the Assyrian king invaded Babylonia and defeated Nebuchadnezzar, capturing his tent furniture and the banner of his army. We may, therefore, place this even in about B.C. 1120. Among the tablets in the British Museum is the Assyrian copy of an inscription of this king's, recording his invasion of the land of Elam, which begins: "When Nebuchadnezzar, the glorious Prince, the beloved offspring of Babylon, exercised royalty"; and relates in an unfortunately fragmentary way the details of this king's invasion of Elam. In the great treasure-room or record-chamber at Abbo Hubba—the ancient Sepharvaim—Mr. Rassam found the Babylonian original of this inscription graven on a fine white marble slab, and accompanied by a series of curious mythological sculptures. The king's reign ended in B.C. 1120, or a few years later, and was, according to a small fragment, at least thirty-two years in length. The Elamite campaign took place in all probability in B.C. 1128, and was preceded by the omen of the comet. Upon this stone we have the king represented seated on his throne, and before him marches a curious figure of a Scorpio-Sagittarius. The body in the upper part is that of a man wearing the royal head-dress and drawing a bow to its fullest extent. The lower part is the body of a scorpion with elevated tail, and the legs are those of an eagle-gryphon. In the text the king assumes titles such as enable us to identify him with the monarch referred to in the omen-tablet. "The legal King, establisher of justice," "the heroic warrior," "the bearer of the strong bow," "the benefactor of men," "the protector of landmarks." Moreover, as he makes no mention of his father, we may assume he was a usurper, and, therefore, "the strong one who exalted himself." From the tablet we learn that the expedition took place in the middle of the month Tammuz (June and July). It will, therefore, be interesting to see if we can identify any comet which appeared at that time in the south-west part of the heavens during the early part of July or the end of June. Among the inscriptions which have arrived at the Museum are a number of astronomical and meteorological omen-fragments, some of which are of the greatest interest, about which I hope to send you notes on some future occasion.

W. St. Chad-Boscawen.

* The Akkadian North was N.W., South, and S.E.

THE POSSIBLE SUSPENSION OF OLD AGE.*

By W. O. Dawson.

IN bygone times those profound mystics and metaphysicians, the Rosicrucians, and still earlier, the Alchemists, claimed to have discovered the Elixir of Life.

They asserted that old age might be retarded, and life considerably prolonged by means of an elixir, preventing, or rather suspending, physical decay. The celebrated English Rosicrucian, Dr. Flood, whose writings became famous, is said himself to have attained the century. Modern science has recently made more startling discoveries than even those of which the Alchemists dreamed. The possibility of prolonging life has throughout all ages been deemed worthy of notice by great thinkers, amongst whose numbers the illustrious Bacon and Hufeland are enrolled. In the following article we shall endeavour to furnish our readers with the latest scientific knowledge relative to the possible suspension of old age. Imprimis—old age is of two varieties—premature, and that caused by the lapse of time. Premature age, as engendered by various mental and physical excesses, comes not within our present notice. The principal characteristics of old age, as demonstrated by anatomical research, are a deposition of fibrinous, gelatinous, and earthy deposits in the system. Every organ in the body during old age is especially prone to these ossific depositions. These earthy deposits have been found to consist principally of phosphate and carbonate of lime, combined with other calcareous salts, according to the researches of Dr. C. T. B. Williams, F.R.S. "That man begins in a gelatinous and terminates in an osseous (or bony) condition" has been truly observed by a French physician. From the cradle to the grave a gradual process of ossification is undoubtedly present; but after passing middle life, the ossific tendency becomes more markedly developed, until it finally ushers in senile decrepitude. These earthy deposits in the various organs during old age materially interfere with the due performance of their respective functions.

Hence we find imperfect circulation in the aged, owing to the heart becoming partially ossified, and the arteries

* We give this article, by the author of "How to Prolong Life" (Simpkin & Marshall), because of the interesting physiological facts on which the theory is based, and without expressing any opinion upon the theory itself. We should be rather glad to hear what Mr. Dawson recommends as the best way of counteracting the effects which he attributes to the oxygen of the air. These effects would disappear altogether if we were to cease breathing, but that seems an inconvenient way of prolonging life.

XUM

blocked with calcareous matter interfering with that free passage of blood upon which nutrition depends, so the repair of the body naturally becomes impaired thereby.

Mr. G. H. Lewes, in his luminous work, "The Physiology of Common Life," truly observes: "If the repair were always identical with the waste, life would then only be terminated by accident, *never by old age.* Both Bichat and Baillie considered that the greater number of persons over sixty suffer more or less from arterial ossification. When the heart's valves become cartilaginous, they consequently fail to propel the blood to its destinations, this fluid being further obstructed by the ossified and contracted condition of the arteries themselves.

In youth, on the other hand, nutrition is perfectly carried out, there being no blockages to impede the circulating system upon the due performance of which physical reparation depends.

Bearing the above facts in mind, we plainly perceive that the *real* change which produces old age *is, in truth, nothing more or less than a slow but steady accumulation of calcareous matter throughout the system.*

It is owing to these depositions that the structure of every organ is altered, their elasticity giving way to senile rigidity. Blockages of various organs then commence, until, at last, one of the vital organs becomes impeded, causing death. The idea that old age was brought about by failure of the so-called vital principle has long since been discarded by science. Now in reality the *true cause* of gradual disintegration in the various organs is the fact that they become inadequately supplied with blood, upon which the renovation of their structures depends.

While speaking of calcareous and osseous degenerations, that eminent authority, Dr. C. T. B. Williams, F.R.S., observes at page 252 of his splendid work, "The Principles of Medicine, "This process is there given to be viewed as almost entirely of a chemical nature, consisting in the concretion and accumulation of calcareous salts, phosphate and carbonate of lime." The *causes* of old age bring, therefore, nothing more or less than ossific deposits. We will now proceed to elucidate the principal influences leading to the condition we have described.

Having arrived at the predisposing causes of senile decay, it yet remains for us to go still further, and seek out their origin. The two principal sources of old age are fibrinous and gelatinous substances; secondly, calcareous depositions. According to the recent researches of Mr. de Lacy Evans, the origin of the former may undoubtedly be traced to the destructive action of atmospheric oxygen, and this proposition is demonstrated by the following argument.

In the air we breathe, the relative proportions of oxygen to nitrogen are 22 to 78. Although oxygen is in far smaller bulk, yet it is the most active element. Now, oxygen has an affinity for every other element except fluorine, thereby forming the oxides. Oxygen plays by far the most important part in those chemical changes constantly at work within the animal economy, life itself being but a constant waste by oxidation, and reparation by food. In the blood exists albumen and fibrine, themselves resolved into component elements—carbon, hydrogen, nitrogen, oxygen, sulphur, and phosphorus. Fibrine has been said to contain 1·5 per cent. more oxygen than albumen. Now, oxidation converts albumen into fibrine, fibrine itself being but an oxide of albumen.

Although unquestionably fibrine nourishes the organs of our bodies by repairing their waste, *yet a great deal of this substance accumulates in course of time, lessening the calibre of the blood-vessels, and thereby causing their induration.*

It therefore follows that, as time goes on (old age), fibrinous and gelatinous depositions become noticeable. Consequently, as fibrine is an oxide of albumen, so also is gelatine an oxide of fibrine, due to the action of oxygen on the fibrine deposited by the blood. A further effect of oxidation causes part of these substances to be decomposed, and subsequently eliminated through the kidneys as compounds of ammonia and urea. There is always a continual struggle progressing in our systems between accumulation and elimination. Thus it is that the fibrinous and gelatinous accumulations of old age are chiefly traceable to the chemical action of atmospheric oxygen.

The calcareous deposits next claim our attention, being proved by anatomical investigation to be peculiarly characteristic of old age.

In the human body water forms 70 per cent. of its aggregate weight, in fact there is not a single tissue which does not contain water as a necessary ingredient. Now water holds certain salts in solution, which become more or less deposited, notwithstanding the large proportion eliminated through the secretions. Nevertheless it is only a matter of time before these minute particles deposited by the blood have a marked effect in causing the stiffness and aridity of advancing life. The reason why in early life the deposit of earthy salts is so infinitesimal is simply because they have not had time to accumulate. It is the old kitchen boiler which is found full of incrustations, not the new one, time not having been sufficient for their deposit. M. Le Canu proved by analysis that human blood contains compounds of lime, magnesia, and iron, averaging 2·1 in every 1,000 parts. This clearly demonstrates that in the blood itself are contained the earth salts, which gradually become deposited in the system.

Blood being made from the assimilation of food, it is therefore to food itself we must primarily look for the origin of these earthy deposits. Besides providing the requisite elements of nutrition, food contains calcareous salts, which, upon being deposited in the arteries, veins, and capillaries, become the proximate cause of ossification and old age. Mr. G. H. Lewes says with truth in his "Physiology of Common Life," "Moreover, in food we are constantly introducing different substances which produce variations in the nutrition of the parts. These differences *accumulate* their influence in those changes named ages, and they culminate in the final change named death."

Having now traced the primary existence of calcareous matter *to food itself,* it is consequently a subject of no small moment to ascertain those varieties of dietetic articles containing these salts. As a matter of fact, everything we eat does contain them to a greater or less degree. The cereals have been found most rich in earth salts; so bread itself, the so-called staff of life, except in great moderation, assuredly favours the deposition of these salts in the system. The more nitrogenous our food, the greater its percentage in calcareous matter; thus a diet composed principally of fruit, from its lack of nitrogen, is best adapted for suspending ossific deposits. Moderation in eating must ever be of great value as an agent for retarding the advent of senility. Large eaters more rapidly bring about these ossific deposits, owing to having taken more food into the stomach than it is able to utilize or excrete, the result being naturally a more rapid blockage. According to the researches of Mr. de Lacy Evans it would appear that the following articles of food contained least of the earth's salts:—1st. Fruits (chiefly owing to their lack of nitrogen). 2nd. Fish and poultry. 3rd. *Young* mutton and veal. Old mutton and beef from age contain a large quantity of earthy matter.

It becomes self-evident, therefore, that living moderately and as much as possible on a diet containing a *minimum amount of earthy* particles is clearly most suitable in order

to retard old age and thereby prolong existence. The most rational treatment with a view to retard old age is in the first place to endeavour as far as possible to *counteract* the excessive action of atmospheric oxygen; secondly, to retard the deposit of ossific matter and as far as possible to dissolve partially-formed calcareous concretions. Distilled water and diluted phosphoric acid are believed by Mr. de Lacy Evans to have the desired effect. When considering their special action we cannot but fully coincide with him as to their efficacy in retarding old age by their combined chemical action. Now distilled water alone has a powerful action owing to its solvent properties, thereby dissolving and excreting the excess of earthy salts which otherwise would become blocked up in the system, gradually storing up those blockages which in time cause old age. The solvent properties of distilled water are so great *per se* that on distillation in vessels it actually dissolves small particles of them. Now the generality of waters contain more or less carbonate of lime, and are to be avoided, especially those from chalky soils, tending as they do to produce calcareous deposits. The action of distilled water as a beverage is briefly as follows:—First, its absorption into the blood is rapid; second, it keeps soluble those salts already existing in the blood, thereby precluding their undue deposit; third, it facilitates in a marked degree their elimination by means of excretion. After middle life *a daily use of distilled water is highly beneficial* to those desirous of retarding old age, and it is also a useful adjunct for adverting stone in the bladder and kidneys.

Lastly we have to deal with the special beneficial action of diluted phosphoric acid when mixed with distilled water and consumed *daily*. If well diluted with distilled water it is perhaps the most powerful means known to science for suspending old age. Diluted phosphoric acid possesses the following great merits:—It prevents the accumulation of earthy salts and also facilitates their elimination. Secondly, by its great affinity for oxygen those fibrinous and gelatinous deposits previously alluded to are held in abeyance by its use. Thus by its *double* agency, combined with distilled water, we have a most valuable preventive against the *primary* causes of old age, which its daily use holds in check. Hypophosphites are believed to exercise a like action, as on becoming phosphates through fixing the oxygen from the blood, undue oxidation (waste of the tissues) is to a great extent prevented.

To sum up shortly what has already been advanced, according to the teachings of modern science the most rational and certain means of retarding old age are by avoiding all foods rich in the earth salts, and by taking *daily* two or three tumblerfulls of distilled water with about 10 to 15 drops of diluted phosphoric acid in each glassful. Thus are the inimical salts held in solution and their excretion daily effected. The means herein advocated have also another great advantage, viz., that they cannot possibly do any harm.

Sub-Editorial Gossip.

Next week the sunrise and sunset column for January, in Whitaker's Almanac, will be discussed and explained. During the next month two zodiacal maps will appear, one showing the sun's course from day to day in January, the other the sign of the zodiac which souths in the middle of the night in January. Pictures will also be given showing the positions of the planets throughout the year 1884. The zodiacal maps will be continued monthly—two in each monthly part, and also the discussion of the details presented in Whitaker's Almanac. It is hoped further that space may be found for a series of monthly star-maps showing the constellation figures, accompanied by Admiral Smyth's curious descriptions of the constellations.

"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to delays arise for which the Editor is not responsible.

All Remittances, Cheques, and Post Office Orders should be made payable to Messrs. Wyman & Sons.

The Editor is not responsible for the opinions of correspondents.

No communications are answered by post, even though stamped and directed envelope be enclosed.

STRANGE LAKE WAVE.

[1065]—On reading in Knowledge, No. 111, the letter (1043) from Port Louis, it occurred to me that the following extracts from a letter written in December, 1792, by the well-known William Cruch, of Edinburgh, and published in the "Edinburgh Fugitive Pieces" (ps. 119 and 121), might interest your readers:—

"In 1782, at the time of the dreadful earthquakes in Calabria, the mercury in the barometer in Scotland sunk within the tenth of an inch of the bottom of the scale; the waters in many of the lochs or lakes in the Highlands were much agitated."

"Upon the 12th of September, 1784, a very extraordinary phenomenon was observed at Loch Tay. The air was perfectly calm, not a breath of wind stirring. About six o'clock in the morning, the water at the east end of the loch ebbed about 300 feet and left the channel dry. It gradually accumulated and rolled on about 300 feet further to the westward, when it met a similar wave rolling in a contrary direction. When the waves met, they rose to a perpendicular height of five or six feet, producing a white foam upon the top. The water then took a lateral direction southward, rushing to the shore, and rising upon it four feet beyond the highest watermark. It then returned, and continued to ebb and flow every seven minutes for two hours, the waves gradually diminishing every time they reached the shore, until the whole was quiescent. During the whole of that week, at a later hour in the morning, there was the same appearance, but not with such violence."

I need scarcely add that Loch Tay is about fourteen miles long and one mile broad at the widest part, having the village of Killin at the west end and that of Kenmore at the east. I could give traditions of other interesting phenomena, showing some connection with earthquakes, but must not occupy your valuable space.

Charles Stewart.

STRANGE SUNSETS.

[1066]—Referring to letters in last two numbers of Knowledge respecting the above, will you kindly allow me to add that here in the West of England we have witnessed it at sunset and also at sunrise? Of several displays I note particularly:—

Date. 1883.	Sunrise.	Sunset.
Nov. 8	.....	Glare, reddish fog.
„ 24	Lurid sky	The whole sky lurid.
„ 29	.....	Deep red glare.
„ 30	The whole sky blood-red	Singular red glare east and west
Dec. 2	.....	Deep red, especially N.W.

The first few observed gave me the idea of an auroral display with (sometimes) rays wide and feebly developed, concentrating towards sun's place as a centre.

I further note that the weird glare attains its maximum brightness about 1¼ hours before sunrise and after sunset, that it dissipates quicker than it gathers, that a diffused (and shifting) but

brighter portion appears about E.S.E. in the mornings, and W.N.W. in the evenings, at an elevation between 20° and 30°. In addition to descriptions given in above letters, I understand that at Trinidad (practically the antipodes of Ceylon) the sun's "face" at rising was "bluish," and about setting time "distinctly blue." Surely the "sulphurous vapours" from the recent Krakatoa eruption cannot be the cause of these singular appearances, comparing Krakatoa (as it was) and the quantity of vapour, &c., emitted, with the enormous area over which the singularly beautiful appearances have been seen.

Sun-spots have been at times numerous, and at others very few, during the last two months. Can any spectroscopist enlighten us as to recent state of protuberances, &c.? THOS. RADMORE.

SHOWER OF PERCH—SUNSETS.

[1067]—Being a constant reader of your valuable journal, I enclose the cutting from to-day's Edinburgh *Scotsman*, of rather a peculiar phenomenon witnessed in Airdrie, viz., a shower of live perch, last Saturday morning, Dec. 15. Now, perch never, or rarely, swim near the surface of the water, and, if drawn up by a whirlwind, it must have been an extra strong current to have drawn them from deep water.

I have been much interested in the papers on the beautiful sunsets lately seen all over the country. I was in Edinburgh last evening, and saw a most peculiar sunset. I watched it from 4 o'clock until 5 o'clock, and it varied from grey to green, then red to a copper colour, then a fiery or blood-red colour. It was a grand sight. I have seen a great many of those peculiar sunsets.

Glasgow, Dec. 17. JOHN A. STEWART.

STRANGE PHENOMENON.

[1068]—Seeing so many meteorological phenomena in your excellent paper, KNOWLEDGE, I am tempted to ask for an explanation of the following, which I saw when on board the British India Company's steamer *Patna* while on a voyage up the Persian Gulf. In May, 1880, on a dark, calm night, about 11.30 p.m., there suddenly appeared on each side of the ship an enormous luminous wheel whirling round, the spokes of which seemed to brush the ship along. The spokes would be 200 or 300 yards long, and resembled the birch rods of the dames' schools. Each wheel contained about sixteen spokes, and made the revolution in about twelve seconds. One could almost fancy one heard the swish as the spokes whizzed past the ship, and, although the wheels must have been some 500 or 600 yards in diameter, the spokes could be distinctly seen all the way round. The phosphorescent gleam seemed to glide along flat on the surface of the sea, no light being visible in the air above the water. The appearance of the spokes could be almost exactly represented by standing in a boat and flashing a bull's-eye lantern horizontally along the surface of the water round and round. I may mention that the phenomenon was also seen by Captain Avern, commander of the *Patna*, and Mr. Manning, third officer. LEE FORE BRACE.

P.S.—The "wheels" advanced along with the ship for about twenty minutes.—L. F. B.

LARGE METEOR.

[1069]—I had the good fortune to see the large meteor, on Nov. 28, and as "Excelsior" would like to have observations from other parts I thought I would send mine. I was observing Saturn with a 2½-in. achromatic when I saw the meteor cross the field of view, and looking up I saw it passing overhead. I was too startled to note the time it occupied, or the very colour; but I noticed particularly the place of disappearance, which was about half a degree west of Gamma Ursa Minoris. Henry T. Vivian writes as follows in *English Mechanic*, Dec. 14. "At 10.35 a brilliant white fire-ball became visible between X i and Eta Draconis at about a third of their distance from the former star, and made a direct course towards the horizon, leaving in its wake a train of small sparks. It vanished about 15° above the horizon." STARGAZER.

Mexboro' Common, near Rotherham.

LUNAR PHOTOGRAPHY FOR SMALL TELESCOPES.

[1070]—The following method requires neither clockwork nor camera, and gives fair results, interesting to the worker, if not scientifically valuable.

Buy a shilling glass-cutter and cut up a Wratten Gelatine "Instantaneous" ¼-plate into small squares with the corners rounded off such as will go inside your lowest power eyepiece and rest on the diaphragm; remove the lenses, screw on a solar dark glass, and use the eyepiece as your dark back; find the visual focus roughly with a piece of ground glass or tissue paper, and find the actinic focus by trial, as described by Mr. Brothers in an early number of KNOWLEDGE. The exposure is made as short as possible by holding a piece of millboard close in front of the object-glass, whipping it away and instantly replacing it. A tenth of a second is quite enough if a strong developer be employed. Of course, due photographic precaution is necessary throughout. The moon's motion during the exposure is less than 2″, a quantity quite inappreciable in such a photograph. A silvered glass reflector makes the method even simpler. H. L. C.

AN ALARMING INCIDENT.

[1071]—Though in the present day of scientific discovery and iron ships, the electric flash has lost many of its terrors, the incident of a vessel being struck by lightning still remains one of the most startling and alarming events that can be met with at sea. This is especially the case when the weather is clear and moderate, and the blow falls in the darkness of the night or of the early morning in the open seaway, for then, not only is danger least expected, but the anxiety and alarm which such an occurrence would naturally inspire at any time must necessarily be prolonged and exaggerated by the difficulty of ascertaining whether any damage has been done or not. It was under such circumstances that the fine screw steamer *Southgate*, of London, was struck last September, whilst on her way, laden with grain, and homeward bound, through the Black Sea from Odessa, and though no permanent harm was inflicted, the feelings of anxious doubt and uncertainty that for a time had place on board can be more easily imagined than described.

At one o'clock in the morning, those who were below were suddenly roused from their sleep by the sound of a fearful crash upon the steamer's side, which, making her shiver and tremble, rang out on the iron like the blow of a heavy hammer. Then quickly followed two other blows, or seeming blows, much weaker than the first, as if some object in the way were being grazed upon. It does not need a sailor to understand how fraught with dangerous meaning such an event must be to the voyager, whose life depends on the soundness of the thin walls of the modern merchant steamer, and sudden as was the waking, and quickly as the blows succeeded one another, the last report had hardly died away when the captain was on deck, looking round in every direction, but in vain, for something to account for the alarming sounds. Strangely as it then appeared, though they had seemed to come from the starboard quarter (*vide* note), just in front of him, there was not a sign of anything unusual to be seen or heard. The heavy rain pattering on the planks, the splash of the waves against the sides, and the regular rattling of the screw alone broke the stillness of the night; and a glance over the bulwarks showed no issuing grain from rent plates, no wreckage telling of a vessel run down, no surf marking the place of an unknown rock.

The true cause, however, did not long remain a mystery, for when he reached the bridge, feeling the deck warm to his bare feet as he went, he found the chief officer just recovered from the stunning effects of an electric flame that had fallen on the steamer in a sudden stream, as the lightning, which all the evening had been continually playing in the heavens in bright floods of thunderless light, passed over her in its course across the sky from west to east. To the startled watchers, it had seemed as though the masts were rattling down around them as the glowing fire poured along the bridge, and over the deck beneath, until it burst on the starboard side with a loud report, which, followed quickly by two sharp thunder-claps, accounted for the sounds that had been heard below. It was but for a moment that the steamer was enveloped in light, and then all was dark and quiet again, though there was little rest for any one on board until a careful search disclosed the comforting fact that not even a mark remained to show the course of the dangerous stream.

From the various accounts of the event the writer heard the following day, he was surprised to gather that the flash, instead of striking the iron masts in the first place and passing along the iron stays to the sides, as might have been expected, appears to have fallen on the water or the stem, and then to have risen over the steamer, for the men who were on the forecastle at the time described the flame as coming up from the sea, whilst some who were hoisting a staysail farther aft, felt it as a hot breath moving in the direction of the stern. It may also be worthy of note that all, whether in the forecastle or in the after cabins, heard the sounds as if the blow had been struck in their immediate neighbourhood, though always on the starboard side.

The incident occurred about latitude 42° 26′ N., and longitude 29° 13′ E. J. TYRRELL BAYLEE.

NOTE.—The starboard quarter is the right hand side, looking from stern to stem, at the stern of a vessel.

TRICYCLES.

[1072]—A correspondent asks for Mr. Browning's opinion on the Omnicycle—may I be allowed to add mine? This year I wished to purchase a tricycle to enable me to recruit health and strength and to be out in the air as much as possible. I had passed through a year of hard work and anxiety; my walking powers were very poor; after a careful examination of the Omnicycle, the "Challenge," the "Imperial Club," and the "Cheylesmore," I decided on the former, and I was delighted with my choice, and I would strongly recommend it to any one who, like myself, wished for a machine in the sense of a tonic. I cannot say much for speed, as I contented myself with six miles an hour; but it was easy to work, the simple up-and-down motion being a little less fatiguing than the rotatory pedal movement. Then, for climbing hills, in my opinion it has no equal. Of course, my experience is limited, but I feel bound to speak highly in its favour. A Medical Man.

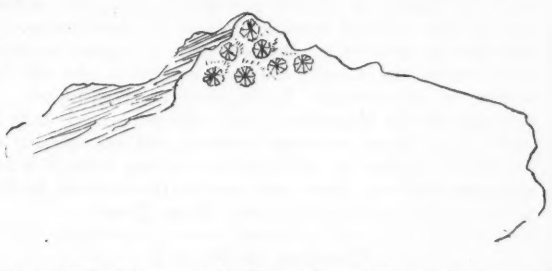
THE OMNICYCLE.

[1073]—In answer to your correspondent, Mr. J. A. Ollard, I can give some information, and should be glad to receive some concerning this tricycle. 1. A rev. gentleman, on whose statement I can depend, informed me that in September last, in the Scotch Highlands, he did 80 miles a day with ease, and that in the week before he wrote me he did 224 miles in four days on the machine in question. Further, he adds: "It is a capital hill-climber; I can go down a gentle slope at twelve miles an hour, and on a good level road ten miles." 2. I should be glad to receive information as to the durability of the working-gear, chains, &c., of the machine from any one who has had some experience of it.

The boxes or cylinders on which the chains work should manifestly be covered up in some way, in order to keep the latter in good order, and to keep them from wet, dust, and mud. The machine has the special advantages that it can be wrought with any length of stroke, has no "dead point," and that it can be started with the treadles in any position. I suggested the obvious, and I think necessary, improvement of covering the cylinders and chains to the makers, as I wished to see that improvement made before buying; but I received no definite answer. W. Hay.

FIND AT BLACKFRIARS.

[1074]—Just a word for your readers, amongst whom I number one. A son of mine in his dinner-hour has wandered on the banks of the Thames at Blackfriars, and has there found many bowls of the very old-fashioned clay pipes, and also specimens of what appears to me to be a kind of coral. It has, as I am now looking at it, a surface as follows, and the apertures descend at least 1½ in.



Is not this rather novel? The coral resembles quartz more than anything else. E. B. Williams.

GROWTH OF NAIL.

[1075]—Six weeks ago I hurt the nail of the first finger of the right hand, and having before noticed from other marks the nail growing, I took means to find out the rate at which it grows. It may be interesting to some of your readers to know the result. I measured the distances each week from the spot to the "quick," taking this latter as a constant position. On July 13, it measured 8 millimètres; on the 20th, 6 mm.; the 27th, 4½ mm.; August 3, 3 mm.; 10th, 2 mm.; 17th, 1 m.; and 24th, entered on a line with the "quick."

From these data, we find that the nail grew $\frac{81}{100}$ of an inch in six weeks, and would take, if it continued to grow at the same rate, just over nineteen weeks to grow an inch, that is, during a year, 2·7 inches. Robert F. Martin.

WEATHER WISDOM.

[1076]—I remember seeing in Knowledge a note intimating that the writer (Mr. J. A. Westwood Oliver, I think) was about to publish a book on "Weather Wisdom," and desiring to hear of any "sayings" thereanent, of which he might not be aware. I have had no means of knowing whether he has published his book yet, but I wonder if he possessed "The Shepherd of Banbury's Rules to Judge of the Changes of the Weather, Grounded on Forty Years' Experience, to which is added a Rational Account of the Causes of such Alterations; the Nature of Wind, Rain, Snow, &c., on the Principles of the Newtonian Philosophy; by John Claridge (1765)."

Observation V., for instance, is "If small clouds increase—much rain"; and in the book, which contains twenty-six "Observations," each with an elaborate "Account" (often with classic references), the following occurs incidentally:—

Janiver freeze the pot by the fire.
If the grass grow in Janiveer,
It grows the worse for't all the year.
The Welshman had rather see his dam on the Beir,
Than to see a fair Februeer.
March wind and May sun
Makes clothes white and maids dun.
When April blows his horn,
'Tis good both for hay and corn,
And April flood
Carries away the frog and her brood.
A cold May and a windy
Makes a full barn and a fendy.
A May flood never did good.
A swarm of bees in May
Is worth a load of hay;
But a swarm in July
Is not worth a fly.

If woolly fleeces spread the heav'nly way
Be sure no rain disturbs the summer day.

In the decay of the moon
A cloudy morning bodes a fair afternoon, &c., &c.

Whiteinch, 1883. W. W.

LETTERS RECEIVED AND SHORT ANSWERS.

B. B.—Lee Fore Brace—E. Brown. Pressure in barometers does not act through the glass.—E. Cannon—H. J. Wykes. Know of none.—W. Gibson. The problem is this, Having given the edge of a cube, to determine by a geometrical construction with the aid only of straight line and circle the edge of a cube which shall be of twice the volume. Of course, any one can *draw* such a line, the length of which may be determined in hundreds of ways. But the geometrical construction in accordance with the conditions named is impossible.—E. A. F. Meteors (including falling stars) are bodies reaching our air from interplanetary space, rendered luminous in their rush through the air. The recent sunsets due probably to meteor dust in upper air.—S. A. Boyd.—S. B. V. There is no reason for supposing the British nation akin to the lost ten tribes. The paradox is an old one, and ought to be, but is not, worn out.—Orrell. Know none.—J. E. Harris. Earth revolves round sun, and earth rotates on its own axis.—H. Clark. See last two or three numbers.—E. S. Marsh—Uncertain. I admit the interest residing in the questions you raise: but it would kill Knowledge if every correspondent with interesting ideas about the natural and the supernatural were dealt with either here or in the open part of the correspondence column. It might probably kill the Editor of Knowledge if he entered into such discussions, however interesting, with all who invited him to do so. He must leave this to those who take interest in such matters.—F. C. Collins. Fear no room. *Do* more play at draughts than at chess?—W. M. Harman—M. F. W.—Ernst Groth, M.D. Thanks; the extracts you have kindly sent suffice to show that the theory is bosh.—J. M. G. The moon is more drawn to the sun than to the earth, yet the earth and moon do not part company. Try the effect of considering not the actual pull of Mars on a particle upon his nearest satellite, but the difference between his pull on any particular particle and his pull on the satellite as a whole.—J. H. Garfit. Reflecting matter high up.—Glenwarr. Thanks; but your observation could not be used for calculation of real path.—Pax. Author could not venture advice.—S. E. I think Dr. Carpenter has written such a work. Image inverted.

Letters Received.—E. A. C., S. Ingham, Squid, G. E. E.

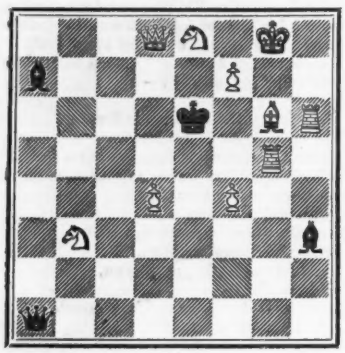
Our Chess Column.

By Mephisto.

OUR CHRISTMAS BIT.

(Great Tragic Pantomime, in which the White King commits suicide after having all his men slaughtered.)

Black.



White.

White to play and self-mate in nine moves.

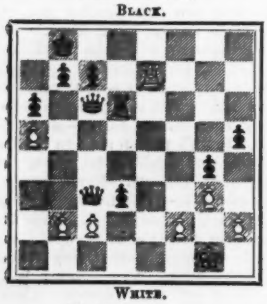
By G. Laws.

How it's Done.

1. Kt to B5 (ch)	1. B takes Kt
2. P to B8 (Kt) (ch)	2. B takes Kt
3. B to Kt sq (disc ch)	3. B takes R
4. Kt to Kt7 (ch)	4. B takes Kt
5. R to K5 (ch)	5. B takes R
6. P to B5 (ch)	6. B takes P
7. B to R2 (ch)	7. Q takes B
8. P to Q5 (ch)	8. Q takes P
9. Q to K7 (ch)	9. K takes Q, mate

The following two positions occurred in games played at Stockton-on-Tees by Mr. Blackburne (presumably at a simultaneous performance) :—

Mr. Appleton.
Black.



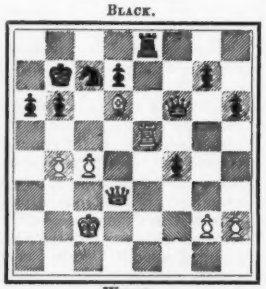
White.

Mr. Blackburne.

White. Mr. Blackburne.	Black. Mr. Appleton.
34. Q to Kt8 (ch)	K to R2
35. R to K8	P to Kt3 (*a*)
36. P takes P (ch)	P takes P (best)
37. R to K7 (ch)	R to Q2
38. Q to K8 (*b*)	R takes R
39. Q takes Q	P to Q7
40. Q to Q6	R to K8 (ch)
41. K to Kt2	P Queens

White draws by check on B7 and B8.

Mr. Appleton.
Black.



White.

Mr. Blackburne.

White. Mr. Blackburne.	Black. Mr. Appleton.
40. B takes Kt	R takes R
41. B takes R	Q takes B
42. Q takes P (ch)	Q to B2
43. Q takes Q	K takes Q
44. K to Q3	K to Q3
45. K to K4	P to KKt4
46. K to B5	P to QKt4
47. P takes P (*c*)	P takes P
48. P to R4	P takes P
49. K takes P	K to Q4
50. K to Kt4	K to B5
51. K takes P	K takes P

And Black won.

NOTES.

(*a*) White threatens R to R8, mate. If Black played the likely-looking move of Q takes R, White would draw by 36. Q takes Q, followed, if P to Q7, by 37. Q to K3, and draws by perpetual check. But if instead of P to Q7, P takes P, then 38. Q to K3 (ch), P to Kt3 (the only hope of escaping a perpetual check). 39. P takes P, K to Kt2. 40. K to Kt2 (best), R to QB3. 41. Q to B sq, P takes P, and White has the better chance. He will proceed by first playing P to B4, and then bringing the K round to Q2 or Q3, and playing P to Kt3, in which case the Black K cannot move into check, as White would play K to B sq. White might then advance his P on the K side. Black would require the utmost care to effect a draw (if that be possible).

(*b*) A very fine move to which there is no good reply.

(*c*) If 47. P to B5 (ch), K to B3. 48. K to Kt6, Black will win by P to QR4.

The Great Sea-Wave.—In the life history of a planet, says Mr. Proctor, there are three stages—a fiery youth, a cool, sedate, and orderly maturity, a sapless and withered old age. Jupiter is just now in the first of these stages, the earth enjoys the second, the moon has degenerated into the third. Without disputing the general theory I take leave to doubt whether Mr. P. has correctly classed the earth. The habits of our planet are still distressingly irregular. In the Strait of Sunda during the last week chaos has literally come again. Subterranean fires have belched forth, sea and sky have been mingled, and of the dwellers in those parts a tidal wave has overwhelmed, it is reported, no less a number than 75,000. This wreckage of human life will perhaps be little accounted of in a region where, as De Quincey remarks, man is a weed. An even greater catastrophe befell in India about 60 years ago, when the Runn of Cutch, 2,000 square miles in area, sank suddenly below the sea with its whole population. The multitudinous East hardly recognised the loss, and in the present case will be barely conscious of the calamity of the 75,000. To my mind this wholesale destruction suggests a doubt whether the planet has yet fairly reached the habitable stage. It is quite clear that the fires of its choleric youth have not burnt themselves out. The sympathetic earthquakes in Queensland, South Australia, and Tasmania which have followed the Java disturbance hint the possibility of further irregularities—perhaps in Cook's Strait, which, like the Strait of Sunda, is an old geologic fracture, and consequently the natural breeding-ground of earthquakes. I apologise for making so uncomfortable a suggestion, especially whilst the Houses are still in session and all the wisdom of the country is collected at Wellington. I apologise for the suggestion, yet I do not exactly take it back. In a planet so young as ours is, and consequently so capable of playing its inhabitants a scurvy trick, it is not altogether wise to plant your seat of Government in the crack of an old geologic fracture.—*Otago Times.*

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SPECIAL NOTICES.

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